observed. 5. Action of silver on iron. A slight effect was produced.

It will thus be seen, that the first experiment described is the one which best exhibits the influence of the magnet. The question still remains, whether the striking effect observed is due to the influence of magnetism on the chemical action, or to some indirect influence of the magnet. An examination of the liquid while the action is going on shows clearly that there are currents in it. Small particles of dust, or any light material, on the surface of the liquid, are drawn towards the poles, and then move in circles above the poles, to the right above one, to the left above the other. We have hence electric currents in the liquid; and these revolve under the influence of the magnet, as we would expect them to. This action gives rise to a streaky condition of the liquid, and this may possibly account for the deposition of copper in the peculiar lines which have been described. I am unable to say whether this satisfactorily accounts for the fact, that the lines of deposit are at right angles to the lines of force; but, as far as I have been able to determine, it does not. Further, if the presence of the currents is the cause of the peculiar deposit of copper on iron, it would appear that the same kind of action should be observed whenever one metal is deposited upon another under the influence of a magnet. This, however, is not the case, as was pointed out above. The fact that the action takes place markedly in the case of iron, and only very slightly, if at all, with other metals, suggests, though it does not prove, that the action is in some way connected with the magnetized condition of the iron. Up to the present I have been unable to experiment with cobalt and nickel. Using nickel-plated brass, I did not succeed in getting any displacement of other metals from solutions by nickel in this condition. Experiments with these metals will of course be of special interest. If it can be shown that with them the same kind of action takes place as with iron, and that with non-magnetic metals it does not take place, the influence of magnetism directly on the chemical action would be practically demonstrated. The slight effects observed with other metals already described may possibly be attributed to the presence of small quantities of iron in the metals experimented upon.

Turning from the ridges of copper deposited on the iron, what is the cause of the space around the outline of each pole upon which no copper is deposited? It is sharply defined; and at the end of the operation it is bright, having remained entirely unaffected by the solution of copper sulphate. Here is evidently a region, not by any means inconsiderable, in which no chemical action has taken place. This can hardly be ascribed to the presence of currents in the liquid. The cause must, I think, be looked for in the magnetized condition of the iron; and I venture, though with misgivings, to suggest, that, the influence of the magnetism being most strongly felt in the iron at the outlines of the poles, these parts of the iron resist the action of the copper sulphate. We may imagine, that the molecules of iron in the regions immediately surrounding the poles are held more firmly than those which are less directly under the influence of the magnet, and that the interference with their motion protects them. Just as, in general, any cause which facilitates the motion of molecules facilitates chemical action, so, also, any cause which interferes with the motion of molecules would probably prevent chemical action either completely or partially. I recognize the crudeness of this suggestion. If there are any objections which can be raised against it, I shall be glad to be informed of them. In the mean time it may at least serve as a working hypothesis, and may lead eventually to a more satisfactory view. I intend to continue experiments on the subject under consideration. Unfortunately, the phenomena which can aid in the solution of the problem appear to be but few, and these do not readily lend themselves to quantitative treatment. The work will necessarily advance slowly, but I shall continue it as long as there appears to be any hope of getting results of value.

IRA REMSEN.

ROTIFERA WITHOUT ROTARY ORGANS.

Professor Joseph Leidy, in a paper recently published in the Proceedings of the Academy of natural sciences of Philadelphia, observes that the Rotifera, or wheel-animalcules, form a small class, abundant in kind, and found almost everywhere in association with algae and with infusorians to which they were formerly considered to belong. Later they were regarded as crustaceans, but now are looked upon as belonging to the group of worms. Their usual striking characteristic, the rotary disks, is not possessed by any well-marked crustacean. Among the Rotifera, however, there appear to be some which do not possess the rotary organs, and yet in all other respects conform in structure to ordinary forms.

Dujardin, Gosse, and Claparede have described rotifers which they regarded as destitute of rotary organs: but Cohn described one with these organs, otherwise resembling the form of Dujardin, and suspects that the latter made a mistake; and remarks that the existence of a rotifer without vibratile cilia would be an abnormal condition in the class. While the forms described by the three authors above named are open to the suspicion that they may possess rotary organs which were withdrawn at the time of

their observation, there can be no question that there are others which are entirely destitute of them, and have efficient substitutes. Of this character is Dictyophora vorax, discovered by Professor Leidy in 1857. The animal is oval, transparent, and fixed in its position. The interior exhibits the usual structure of rotifers, together with the powerful muscular pharynx armed with jaws, observed to be in frequent motion. From the truncated extremity of the body the animal projects a capacious delicate membranous cup more than half the size of the body. The cup is a substitute for the rotary disks of ordinary rotifers, and is used as a net to catch food. At will it is entirely withdrawn into the body with its prey. The animal feeds on smaller animalcules; and in one instance upwards of fifty of these, mostly entomostracans, were squeezed from the stomach. With extended net, the animal measures up to 1 mm. in length. It was found in the Schuylkill River, attached to stones and aquatic plants, and also was observed attached to the sides of an aquarium.

Mecznikow, in 1866, described a similar rotifer under the name of Apsilus lentiformis, found at Giessen, attached to the leaves of the Nymphaea lutea. It especially differs from Dictyophora in the possession of bristled tentacles, and a ganglion to the pouch. Recently, also, Mr. S. A. Forbes of Normal, Ill., has described a similar rotifer with the name of Cupelopagus bucinedax; but this Professor Leidy suspects to be the same as the Dictyophora.

Later Professor Leidy has discovered another remarkable form, which he has named, from the absence of rotary organs, and its restless habit, Acyclus inquietus. It was found attached to the stems of Plumatella, a ciliated polyp, on stones in the Schuylkill River. It was always single, enclosed in profuse bunches of the familiar rotifer Megalotrocha, from which it was rendered conspicuous by its larger size, resembling a giant in a crowd. For the most part, in general structure it resembles Megalotrocha; but as a substitute for the rotary disks of the latter, it possesses a large cup-like head prolonged at the mouth into an incurved beak. The cup is retractile and protrusile, contractile and expansile. When protruded and expanded, the mouth gapes widely, and the beak becomes more extended, but always remains incurved. The animal bends incessantly in all directions, and it contracts and elongates in accord with its surrounding associates. It frequently bends, almost doubling on itself, so as to bring its prehensile mouth within the play of the currents produced by the rotary disks of the Megalotrochae, while the mouth expands and contracts so as to grasp a portion of the food brought within its reach. The movements of the animal are somewhat of a grotesque character, and reminded the author of a zealous demagogue addressing a crowd, obsequiously bowing, and greedily accepting contributions. The length of Acyclus is up to 1.5 mm. in length. The embryo at the time of its escape from the egg is a worm-like body, having the mouth furnished with vibratile cilia.

The original paper is furnished with illustrations representing both Dictyophora and Acyclus.

In one instance Professor Leidy remarks, that he had the opportunity of seeing an individual of Plumatella, with outspread arms, and in its immediate vicinity a group of Megalotrochae with open disks and an Acyclus in its midst, together with two worms of the genus Dero, with extended and expanded branchial tails, all acting together in concert, apparently perfectly regardless of the presence of one another, — messmates partaking of the same repast.

RHYTHMIC MUSCULAR CONTRACTIONS.

CONTINUING those researches on the physiology of the contractile tissues to which we owe so much, Engelmann has lately been at work (*Pflüger's archiv*, xxix. 1882) on the arterial bulb of the frog's heart; selecting it as a muscular organ which contracts rhythmically on stimulation. Preliminary careful study with the aid of some of his pupils confirmed the result of all previous workers, that the bulb contains no nerve-cells. Löwit, however, just as Engelmann had finished his work, described a 'bulbus ganglion:' this led to a fresh histological examination, also fruitless, so that Engelmann finally asked Löwit to send him some of his preparations. These were received and examined. Engelmann unhesitatingly asserts that the supposed nerve-cells are nothing but endothelial elements and connective tissue corpuscles. The isolated arterial bulb is accordingly nothing but a mass of muscular, connective, and epithelial tissues; nevertheless, when filled with blood serum under a suitable pressure, it, like the apex of the ventricle, executes slow rhythmic pulsations. These cease in ten or fifteen minutes, but after a while recommence, and may continue for hours. A single sudden stimulus of moderate strength applied in any pause between two pulsations calls forth, not as in the case of the ventricle a single contraction, but a rhythmic series of such. A weaker stimulus leads to only one beat, or none. Any part of the musculature of the bulb has this property, even pieces cut off and so minute as to need a lens for their observation. It is therefore undoubtedly a property of the muscle elements themselves. The muscle is also conductive: a stimulus applied to a portion united only by a narrow uncut strand with another portion, will arouse contractions in the latter. The stronger the stimulus, up to a maximum limit, the greater the number of pulsations in the series which follows its application, and the less the intervals between the individual contractions of the series. The influence of successive stimuli at not too short (3–5″) intervals is like that observed by Bowditch on the ventricular apex. After long rest, irritability and contractility are diminished; if then equal successive stimuli be applied, of such strength that each only arouses one beat, each beat is more powerful than that which preceded it, until a maximum is reached; at the same time a weaker stimulus than that required at the end of the period of rest becomes sufficient to excite a contraction. Each pulsation nevertheless temporarily exhausts the muscle; if the stimuli follow at less than 2″ intervals, the successive results are smaller. The contraction is always maximal for the given condition of the muscle: a strong stimulus causes no more powerful contraction than a weak, provided the latter acts at all. As in other muscles, a stimulus in itself too weak to cause a contraction makes the organ more sensitive to succeeding stimuli. As a result of this, rapidly repeated (tetanizing) stimuli at first too feeble to influence the bulb may after a time make it give an occasional beat, and ultimately cause rhythmic pulsations: that is, practically continuous stimulation gives rise not to continuous but to periodic contraction. These experiments go far in support of the view which has been gaining ground for some time back, that the rhythm of the heart's action is due not to intermittence in the stimulation sent from its ganglia to its muscle fibres, but to a property of the cardiac muscle tissue itself. The paper also contains interesting experiments on the influence of warmth and cold, and of varied